

**PATENT**  
Attorney Docket No. 305336

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:

Gridley et al.

Application No. 09/492,602

Art Unit: 1733

Examiner: J. Fischer

Filed: January 27, 2000

For: **METHOD AND APPARATUS FOR  
RETREADING TIRES**

**PENDING CLAIMS AFTER AMENDMENTS  
MADE IN RESPONSE TO OFFICE ACTION DATED SEPTEMBER 26, 2001**

23. (Amended) A method of retreading tires, comprising:  
mounting a tire casing on a hub, the hub being rotatable;  
applying a length of cushion gum around the circumference of the tire casing,  
said cushion gum being dispensed at a linear velocity that is less than the tangential  
velocity of the periphery of said tire casing such that the cushion gum adheres to said  
tire casing as a result of stretching of the length of cushion gum being controlled  
during application;  
measuring, automatically, the circumference of the tire casing;  
dispensing, automatically, a length of tire tread based on the measured  
circumference of the tire casing;  
adjusting the length of said tire tread so that, after being cut, first and second  
ends of the tire tread will provide a substantially continuous tread design when  
brought together on the casing;  
cutting said length of tire tread; and  
applying the cut length of tire tread to the tire casing,  
wherein the applying, measuring, dispensing, providing, and applying are  
performed on an integrated machine.
  
24. The method of claim 23, further comprising:  
measuring the circumference of the tire casing.

25. The method of claim 24, further comprising:  
rotating the hub at an angular rate based on the circumference of the tire casing.
26. The method of claim 23, further comprising:  
cutting the tire tread to an automatically determined length.
27. The method of claim 23, further comprising:  
cutting the tire tread to an operator determined length.
28. The method of claim 23, further comprising:  
cutting the tire tread to a length based on the tire tread design.
29. The method of claim 23, wherein applying the length of tire tread includes controlling an application pressure.
30. The method of claim 23 further comprising:  
stitching the cushion gum to the tire casing.
31. The method of claim 23 further comprising:  
dispensing cushion gum at a rate dependent upon a tangential velocity of the periphery of said tire casing
32. The method of claim 23 further comprising:  
monitoring the circumferential distance of the casing and the cushion gum not covered by the tire tread;  
monitoring the length of tire tread not applied to the casing and the cushion gum; and  
controlling the pressure applied to the tire tread during application, the pressure applied to the tread based on the circumferential distance of the casing and the cushion gum not covered by the tire tread and the length of tire tread not applied to the casing and the cushion gum.

33. The method of claim 23 further comprising:

stitching the tire tread to the casing and the cushion gum.

34. The method of claim 33 wherein monitoring the circumferential distance of the casing and the cushion gum not covered by the tire tread occurs substantially continuously and monitoring the length of the tread not applied to the casing and the cushion gum occurs substantially continuously.

35. An apparatus for retreading tires, comprising:

a tire casing mount configured to have a tire casing mounted thereto;

a cushion gum applicator including a drive mechanism for contacting said tire casing along its periphery, said gum applicator including gears that connect to a dispensing mechanism which dispenses cushion gum at a linear velocity that is less than the tangential velocity of said tire casing, said cushion gum applicator thereby configured to stretch and adhere a length of cushion gum onto the tire casing;

a tread dispenser configured to automatically dispense a length of tire tread based on the circumference of at least one of the tire casing and the tire casing plus the cushion gum, the tread dispenser including a tread cutter for cutting the tread to define the length of tread such that the length of tread has a first end and a second end, the length of tread having a periodically repeating tread pattern, and the tread dispenser configured to allow the tire tread to be adjusted relative to the tread cutter for defining the length of tread such that the tread pattern at the second end substantially matches the tread design at the first end; and

a tread applicator configured to apply the length of tire tread onto the casing over the cushion gum;

wherein the cushion gum applicator, the tread dispenser, and the tread applicator are integrated into a single machine.

36. The apparatus of claim 35 further comprising:

a measuring device configured to measure at least one of the circumference of the tire casing and the circumference of the tire casing plus the cushion gum.

37. The apparatus of claim 35 further comprising:  
a curved track for guiding the length of tire tread therealong so that the tire tread contacts said tire casing substantially tangentially to said casing.
38. The apparatus of claim 37 wherein the tread dispenser further includes a first clamp for clamping the length of tire tread adjacent a first end, and a second clamp for clamping the length of tire tread adjacent a second end.
39. The apparatus of claim 38 wherein the first clamp includes a first clamp encoder, and the second clamp includes a second clamp encoder, the first and second clamp encoders configured to track the location of the first and second clamps, respectively, along the track.
40. An apparatus for retreading tires, comprising:  
a rotatable hub for mounting a tire casing;  
a cushion gum applicator configured to stretch a length of cushion gum onto the tire casing, the stretch being controlled during application relative to the tangential velocity of the periphery of the tire casing;  
a tread dispenser configured to automatically dispense a length of tire tread based on the circumference of at least one of the tire casing and the tire casing plus the cushion gum, said tread dispenser permitting said tread to be cut in such a manner that, once the tread is applied, the design pattern of the tire tread will appear substantially continuous; and  
a tread applicator configured to apply the length of tire tread onto the cushion gum;  
wherein the cushion gum applicator, the tread dispenser, and the tread applicator are integrated into a single machine.
41. The apparatus of claim 40 further comprising:  
a measuring device configured to measure the circumference of the tire casing.

42. The apparatus of claim 40 further comprising:  
a measuring device configured to measure the circumference of at least one of the circumference of the tire casing and the circumference of the tire casing plus the cushion gum.
43. The cushion gum application system of claim 40 further comprising:  
a drive configured to rotate the hub and casing combination at an angular rate based on the circumference of the tire casing.
44. The cushion gum application system of claim 40 further comprising:  
a rotatable spindle for mounting a roll of cushion gum thereon and dispensing a length of cushion gum therefrom.
45. The cushion gum application system of claim 44 further comprising:  
a drive configured to rotate the hub and casing combination at an angular rate based on the circumference of the tire casing, wherein the drive is configured to rotate the hub and casing combination at a first angular rate, the spindle at a second angular rate, and wherein the second angular rate is based on the first angular rate.
46. The cushion gum application system of claim 45 wherein the drive is configured to rotate the hub and casing combination such that a point on the perimeter of the tire casing has a first tangential velocity, a point on the perimeter of the roll has a second tangential velocity, and wherein the first tangential velocity minus the second tangential velocity provide a nonnegative differential velocity.
47. The cushion gum application system of claim 46 wherein the drive is configured such that the differential velocity is substantially constant during application of the cushion gum.

48. The cushion gum application system of claim 40 further comprising:  
a set of stitching rollers configured to engage the cushion gum and provide pressure on the cushion gum as the tire casing is rotated, thereby providing enhanced adhesion of the cushion gum to the tire casing.

49. The cushion gum application system of claim 40 wherein the cushion gum applicator is cementless and the stretched cushion gum substantially adheres to the tire casing.

50. An apparatus for retreading tires, comprising:  
a rotatable hub for mounting a tire casing, the tire casing having a circumference;  
a cushion gum applicator configured to apply a length of cushion gum onto the tire casing, wherein said applicator dispenses said cushion gum at a rate which is less than the tangential velocity of the periphery of said tire casing to thereby stretch said cushion gum onto said tire casing;  
a tread dispenser configured to automatically dispense a length of tire tread based on the circumference of at least one of the tire casing and the tire casing plus the cushion gum, the tread dispenser including a tread cutter for cutting the tread to define the length of tread such that the length of tread has a first end and a second end;  
a track configured to receive the length of tread from the tread dispenser and to provide the length of tire tread to the casing; and  
a variable force tread applicator configured to apply the length of tire tread onto the casing with the cushion gum disposed therebetween, wherein the variable force applicator is configured to apply the tread to the casing with a variably controlled force that is based on the circumferential distance of the casing and cushion gum not yet covered by the tire tread and the length of tire tread not yet applied to the casing and cushion gum;  
wherein the cushion gum applicator, the tread dispenser, the track, and the variable force tread applicator are integrated into a single machine.

51. The apparatus of claim 50 further comprising:
- a first track encoder, the first track encoder movable along the track, the first track encoder configured to mount to the tire tread at a predetermined distance from the first end;
  - a second track encoder, the second track encoder movable along the track, the second track configured to mount to the tire tread at a predetermined distance from the second end, the first and second track encoders cooperating together to determine the locations of the first and second ends of the tread relative to each other while the first and second ends are disposed on the track, the second track encoder configured to determine the location of the second end of the tire tread relative to the casing during the application of the tire tread to the casing such that the length of tire tread not yet applied to the casing can be determined; and
  - a hub encoder, the hub encoder configured to determine the location of the first end of the tire tread relative to the casing during the application of the tire tread to the casing such that the circumferential distance of the casing not yet covered by the tire tread can be determined.
52. The apparatus of claim 51 further comprising:
- a unit monitoring the length of tire tread that has been applied to the casing and the length of tire tread that has yet to be applied and varying the force applied by the variable force applicator based on the difference therebetween.
53. The apparatus of claim 52 wherein the unit substantially continuously monitors the length of tire tread that has been applied to the casing and the length of tire tread that has yet to be applied.
54. The apparatus of claim 50 wherein the variable force tread applicator is configured to stretch the tire tread onto the casing such that when the tire tread has been applied to the casing, the first end and the second end define a gap therebetween, the gap being within a predetermined range of distances.

55. The apparatus of claim 50 wherein the variable force tread applicator includes an applicator roller, the applicator roller movable in a direction substantially normal to the circumference of the tire casing to apply a variably controlled force to the tire casing.

56. The apparatus of claim 50 wherein the cushion gum and the tire tread are substantially aligned, and the hub is adjustable laterally in the direction of the axis of rotation of the hub to align the casing with the cushion gum and the tire tread.

57. The apparatus of claim 50 further comprising:

a measuring device, the measuring device configured to measure at least one of the circumference of the tire casing and the circumference of the tire casing plus cushion gum.